

PATENT COOPERATION TREATY

From the:
INTERNATIONAL SEARCHING AUTHORITY

To:

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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year) - 5 AUG 2004

Applicant's or agent's file reference
FP19881

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/AU2004/000913

International filing date (day/month/year)
7 July 2004

Priority date (day/month/year)
7 July 2003

International Patent Classification (IPC) or both national classification and IPC
Int. Cl. ⁷ C01B 3/02, C12P 3/00, H01M 8/16

Applicant
UNIVERSITY OF QUEENSLAND et al

1. This opinion contains indications relating to the following items:

- | | | |
|-------------------------------------|--------------|--|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the opinion |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input checked="" type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input checked="" type="checkbox"/> | Box No. VIII | Certain observations on the international application |

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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Box No. I Basis of the opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material
☐ a sequence listing
☐ table(s) related to the sequence listing
 - b. format of material
☐ in written format
☐ in computer readable form
 - c. time of filing/furnishing
☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

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Box No. IV Lack of unity of invention

1. ☐ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has:
- ☐ paid additional fees
 - ☐ paid additional fees under protest
 - ☐ not paid additional fees
2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with
 - ☒ not complied with for the following reasons:

The Written Opinion of the ISA has been drawn up in respect of the entire international application but the International Preliminary Examining Authority is of the opinion that the application does not appear to comply with the requirements of unity of invention as set forth in the PCT regulations (Article 34(3), Rule 68(1) PCT).

The separate groups of invention are:

1. Claims 1-22, 27 and 28 are directed to a process for the production of hydrogen using a hydrogenase-expressing microorganism, capable of photosynthetic electron transfer, wherein regulation of the mitochondrial electron transport chain is disrupted such that electron transfer to cytochrome oxidase is reduced.
2. Claims 23 and 24 are directed to a process for the enhancement of biomass using a hydrogenase-expressing microorganism, capable of photosynthetic electron transfer, wherein regulation of the mitochondrial electron transport chain is disrupted such that electron transfer to cytochrome oxidase is reduced.
3. Claims 25 and 26 relate to a process for sequestering carbon from an external nutrient supply using a hydrogenase-expressing microorganism, capable of photosynthetic electron transfer, wherein regulation of the mitochondrial electron transport chain is disrupted such that electron transfer to cytochrome oxidase is reduced.

These groups are not so linked as to form a single general inventive concept, that is, they do not have any common inventive features, which define a contribution over the prior art. The common concept linking together these groups of claims is the microorganism with the above features. However this concept is not novel in the light of D1.

Therefore these claims lack unity *a posteriori*.

4. Consequently, this opinion has been established in respect of the following parts of the international application:

- ☒ all parts
- ☐ the parts relating to claims Nos.

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Box No. V **Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims 1-26, 28	YES
	Claims 27	NO
Inventive step (IS)	Claims 1-22, 28	YES
	Claims 23-27	NO
Industrial applicability (IA)	Claims 1-28	YES
	Claims	NO

2. Citations and explanations:

The following documents identified in the International Search Report have been considered for the purposes of this report:

D1: Hippler, M. *et al.* Biochimica et Biophysica Acta (1998) 1367(1-3): 1-62

Novelty (N) claim 27

The invention defined in claim 27 is not novel over the disclosure of D1 which teaches *C.reinhardtii* algal cultures deficient in mitochondrial respiratory chain function due to (i) the addition of inhibitors to the wildtype organism (see page 43, right column) or (ii) a genetic mutation affecting nuclear or mitochondrially-encoded components of the mitochondrial electron transport chain (see page 53 right column to page 54 left column).

Claims 1-22 and 28 meet the criteria set forth in PCT Article 33(2) for novelty. The prior art published before the priority date does not disclose a process for producing hydrogen using a hydrogenase-expressing photosynthetic microorganism having disrupted mitochondrial respiration such that electron transfer towards cytochrome oxidase is reduced. Similarly the features of claims 23-26 are also not disclosed in the prior art.

Inventive Step (IS) claims 23-27

Claim 27 is not inventive for the reasons given above.

The invention of claims 23-26 is not inventive over the teaching of the closest prior art, D1. The technical problem addressed by claims 23-24 is to provide a process for the enhancement of biomass production, while claims 25-26 provide a process for sequestering carbon from an external nutrient supply. The method of increasing biomass production by culturing a microorganism of D1 with a carbon source under illuminated conditions would be obvious to the skilled person, as would the ability of such a microorganism to fix carbon, therefore claims 23-26 do not involve an inventive step.

Claims 1-22 meet the criteria set out in PCT Article 33(3) with regard to the requirement of inventive step because the prior art does not obviously suggest to a person skilled in the art that inhibition of mitochondrial respiration resulting in reduced electron transport to cytochrome oxidase would enhance hydrogen production in the photosynthetic microorganism as defined in these claims.

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 23-26 are not supported by the description as they do not include as a feature the inventive concept. It appears from the description that the inventive concept relates to the finding that hydrogen production by photosynthetic microorganisms is enhanced when electron transfer through the electron transport chain to cytochrome oxidase is reduced. Hydrogen production however is not a feature of claims 23-26, which instead claim processes for the enhancement of biomass production and for sequestering carbon and therefore these claims are not supported by the description.